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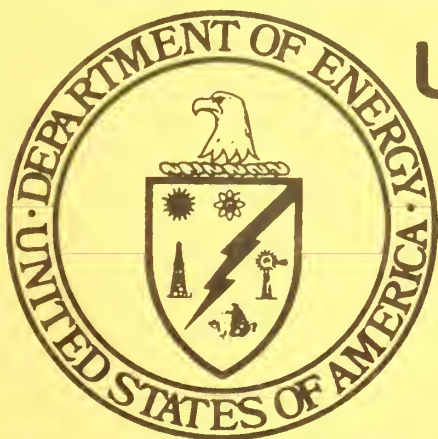
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SOLAR/2009-79/04

Monthly Performance Report

RADEMAKER CORPORATION

APRIL 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT
RADEMAKER CORPORATION
APRIL 1979

I. SYSTEM DESCRIPTION

The solar energy heating system at Rademaker Corporation is designed to provide 50 percent of the space heating and 50 percent of the domestic hot water preheating for a 10,000-square foot office and warehouse building in Louisville, Kentucky. The solar installation, by design, consists of two separate solar energy systems. One system utilizes liquid as the energy transfer medium; the other system utilizes air as the transfer medium. The purpose of separate solar energy systems was to evaluate the merits of each system in meeting a common space heating load. The two solar heating systems are shown schematically in Figure 1.

The liquid system has an array of six flat-plate collectors with a gross area of 240 square feet. The array faces south at an angle of 53 degrees from the horizontal. A solution of 46 percent propylene glycol and 54 percent water is employed as a heat transfer medium. Solar energy is stored in a 560-gallon thermal storage tank located in the warehouse. Solar energy is transferred to meet the space heating demand by two methods. In the first method, solar heated hot water is circulated on demand, from water thermal storage to heat exchangers HX2 and HX3 in the supply ducts of the drafting room and perimeter zone, respectively. In the second method, the glycol and water solution in the collection loop is directed, on demand, to heat exchanger HX4 in the supply duct of the perimeter zone. Circulation fans F2 and F3 distribute the solar energy to meet the space heating loads. Energy is also distributed to a domestic hot water heat exchanger that extracts solar energy from the glycol and water solution to preheat domestic hot water in the building.

The air system has an array of 10 flat-plate collectors with a gross area of 195 square feet. The array faces south at an angle of 33 degrees

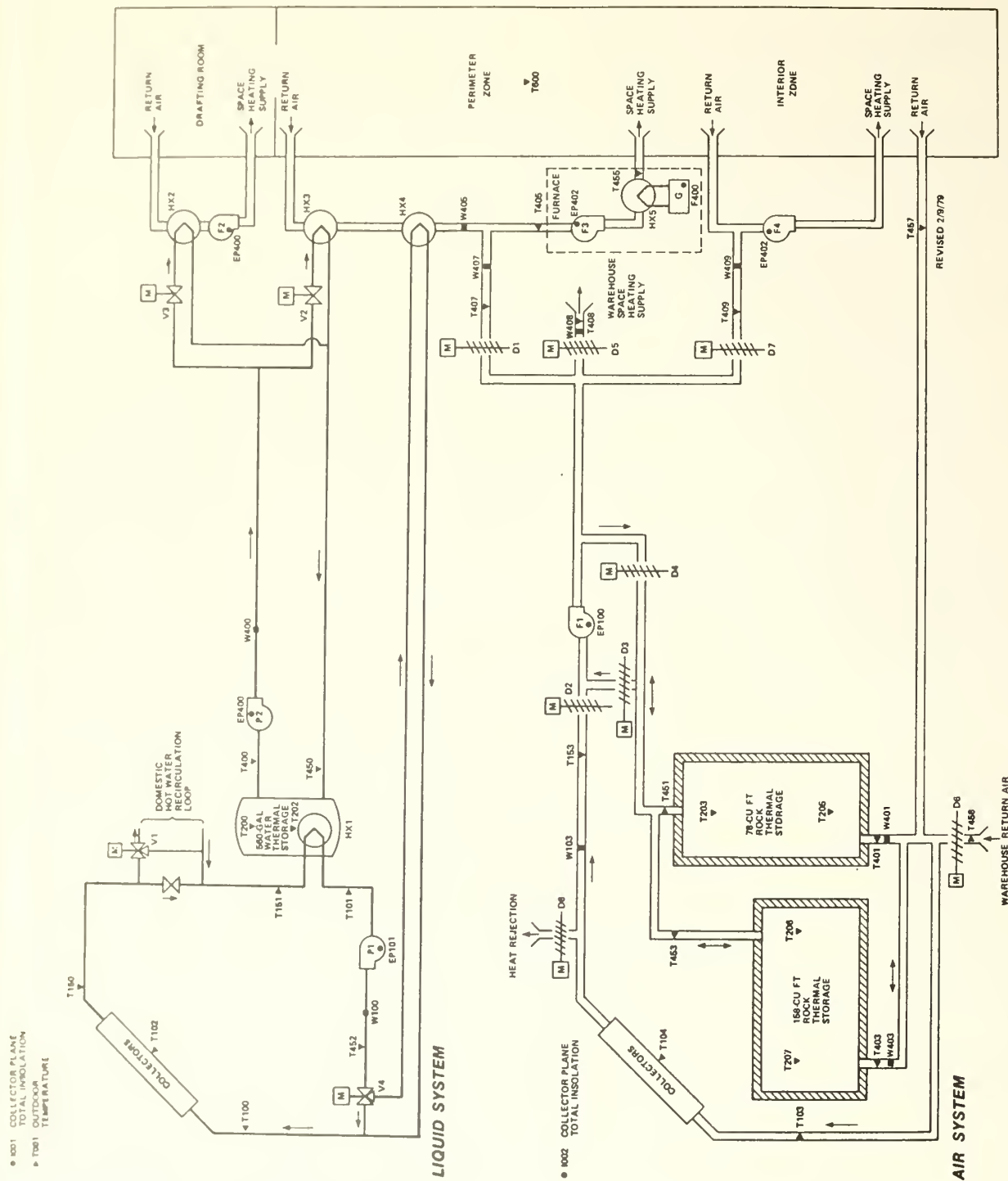


Figure 1. RADEMAKER CORPORATION SOLAR ENERGY SYSTEM SCHEMATIC

from the horizontal. Solar energy is stored in two rock thermal storage units in the warehouse which contain a total of 236 cubic feet of crushed rock. Solar energy is transferred to meet the perimeter, warehouse, and interior zone space heating demands using circulation fan F1. Circulation fans F3 and F4 distribute energy to the perimeter and interior zones, respectively. Solar heated air can be distributed directly from the collectors, or from rock thermal storage to meet the space heating loads. The solar energy control system determines which space heating load received solar energy when a demand exists. The solar space heating load priorities are: first, interior zone heating; second, perimeter zone heating; and third, warehouse heating.

Solar heated air from the liquid system is mixed in the air-handling unit plenum with solar heated air from the air system and distributed to the perimeter zone using circulation fan F3. When solar energy is inadequate to provide perimeter zone space heating, auxiliary thermal energy is supplied by a natural-gas furnace.

The liquid system has four modes of operation.

Mode 1 - Collector-to-Storage: This mode is entered when the difference between the collector outlet temperature and the water thermal storage temperature is greater than 14°F. Pump P1 circulates the liquid through the collectors, then to storage heat exchanger HX1 and returns to the collectors. Circulation continues in this mode until the temperature difference between the collector outlet and storage is less than 4°F.

Mode 2 - Storage-to-Conditioned Space: This mode is entered when two conditions are satisfied: first, a demand for space heating exists; secondly, the temperature of the storage water is above 85°F. Water is circulated from storage to heat exchangers HX2 and HX3 located in the supply ducts of the drafting room and perimeter zone. Air circulation fans F2 and F3 distribute the solar energy to the space heating zones. This mode continues until the storage temperature is below 85°F or the demand for space heating is satisfied.

Mode 3 - Collector-to-Conditioned Space: This mode is entered when two conditions are satisfied: first, the temperature of the liquid at the outlet side of heat exchanger HX1 is greater than 120°F; secondly, there is a demand for space heating from the perimeter zone. Solar energy is directed by valve V4 to heat exchanger HX4 in the supply duct of the perimeter zone. Fan F3 distributes the solar energy to the perimeter zone. This mode continues until either the temperature at the outlet of heat exchanger HX1 is less than 120°F, or the demand for space heating is satisfied. Auxiliary space heating supplements solar energy for the perimeter zone.

Mode 4 - Domestic Hot Water Preheating: This mode is entered when solar hot water heating is desired and solar energy is available from the collectors. Solar energy is directed from the collector loop through the domestic hot water (DHW) recirculation loop to preheat hot water for DHW consumption. A high limit thermostat shuts off the flow to the DHW heat exchanger in the recirculation loop when the liquid temperature exceeds 180°F.

The air system has four modes of operation.

Mode 5 - Auxiliary Space Heating: This mode is entered when the collectors are inactive, the storage temperatures of both solar systems are below 85°F, and a demand for space heating exists. Circulation fan F3 supplies auxiliary energy from the furnace to the perimeter zone. Circulation continues in this mode until the demand for space heating is satisfied or solar energy is available from either the collectors or storage.

Mode 6 - Collector-to-Storage: This mode is entered when two conditions are satisfied: first, the difference between the collector outlet temperature and the bottom of storage is greater than 14°F; secondly, there is no demand for space heating. Fan F1 circulates air from storage, through the collectors, and then back to storage. Circulation continues in this mode until the differential temperature is less than 4°F, or until a demand for space heating occurs. In this mode, motorized dampers

D1, D3, D5, D6, D7 and D8 are closed, and motorized dampers D2 and D4 are opened.

Mode 7 - Storage-to-Conditioned Space: This mode is entered when a demand for heating exists, the collector loop is inactive, and the top of rock thermal storage is above 85°F. Fan F1 circulates building return air through storage and supplies solar heated air to the space heating zone demanding heat. The solar control system determines which space heating zone is supplied with heat. Circulation continues in this mode until the storage temperature drops below 85°F, or the demand for space heating ceases. In this mode, motorized dampers D1, D5, D6 and D7 are opened, or closed, depending upon which area requires heat. For proper air circulation through storage, dampers D2 and D4 are closed, and D3 is opened.

Mode 8 - Collector-to-Conditioned Space: This mode is entered when two conditions are satisfied: first, a demand for space heating exists from the perimeter zone, interior zone, or warehouse; secondly, the differential temperature between the collector outlet and the bottom of rock thermal storage is greater than 14°F. Fan F1 circulates air from conditioned space through the collectors and supplies solar heated air to area demanding heat. The solar control system has a priority scheme that determines the order in which zone is supplied heat. Fans F3 and F4 assist in the air distribution. This mode continues until either the differential temperature between the collector outlet and the bottom of storage is less than 4°F, or the demand for space heating ceases. The auxiliary furnace supplements solar energy for the perimeter zone only. In this mode, motorized dampers D1, D5, D6 and D7 are either opened, or closed, as determined by heating requirements. To circulate air only through the collectors, motorized dampers D3, D4 and D8 are closed, and damper D2 is opened.

The liquid system and the air system operate independently; however, either system may be used in conjunction with the auxiliary furnace to satisfy a heating demand.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluations Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

In the month of April, the load was predominantly space heating and equally shared between the liquid and the air systems.

During April, 63 percent of the 5.38 million Btu space heating system load was provided by solar energy, resulting in a fossil energy savings of 8.17 million Btu at an electrical energy cost of 0.56 million Btu.

For the air system, 62 percent of the 2.69 million Btu system load was provided by solar energy, resulting in a fossil energy savings of 3.37 million Btu at an electrical energy cost of 0.30 million Btu. The energy collection and storage subsystem and the space heating subsystem were operational during the entire month.

For the liquid system, 64 percent of the 2.69 million Btu space heating system load was provided by solar energy, resulting in a fossil energy savings of 3.51 million Btu at an electrical energy cost of 0.26 million Btu. The energy collection and storage subsystem, the space heating subsystem, and the DHW preheating subsystem were operational during the entire month.

B. Weather

During April, the temperature in Louisville, Kentucky was cooler than normal, as evidenced by an average outside ambient temperature of 54°F when compared to the long-term value of 56°F. This long-term value was obtained from the climatological data for the city of Louisville, Kentucky.

The average insolation of 1,301 Btu/ft²-day was less than the long-term value of 1,363 Btu/ft²-day, obtained from an algorithm that projects the mean daily horizontal insolation into the plane of the collectors.

C. Thermal Performance (Liquid System)

Collector - During April, 9.37 million Btu of solar energy were incident upon the collector array, and 8.34 million Btu were incident during the operation of the subsystem. From this amount, 3.12 million Btu were collected, resulting in a collector array efficiency of 33 percent. A total of 1.18 million Btu of electrical energy was required to operate the subsystem.

Storage - From the 3.12 million Btu of solar energy that were collected, 0.64 million Btu were delivered to the DHW preheating subsystem, 2.08 million Btu were delivered to thermal storage, and the remaining 0.40 million Btu were lost during transport. From storage, 0.12 million Btu were removed from the space heating subsystem and 0.42 million Btu were lost to the warehouse, resulting in a storage efficiency of 0.80 percent. The average storage temperature was 91°F.

Space Heating - A total of 1.72 million Btu of solar energy was delivered to the subsystem. Of the total auxiliary energy used (2.0 million Btu), 0.97 million Btu of thermal energy were apportioned to the liquid system.

A total of 1.02 million Btu of electrical energy was required to operate the subsystem, including the apportioned furnace air handler blower power. Solar energy supplied 64 percent of the 2.69 million Btu subsystem load, resulting in a fossil energy savings of 3.51 million Btu, at an electrical energy cost of 0.10 million Btu.

Domestic Hot Water - The DHW subsystem is instrumented to identify the energy extracted from the collected energy and delivered to the DHW recirculation loop. The operating energy and the energy used by the DHW load cannot be identified. The solar energy delivered to the subsystem was 0.67 million Btu.

D. Thermal Performance (Air System)

Collector - During April, 7.98 million Btu of solar energy were incident upon the collector array, and 7.54 million Btu were incident during the operation of the subsystem. From the incident energy, a net amount of 2.19 million Btu was collected.

The collector array efficiency was 28 percent. A total of 0.30 million Btu of electrical energy was required to operate the subsystem.

Storage - From the net amount of 2.19 million Btu of solar energy that was collected, 0.81 million Btu were delivered to storage, and the remainder was delivered directly to the space heating load or lost in transport.

The net energy from storage was 0.40 million Btu and the storage efficiency was 55 percent. The average daily storage tank temperature was 73°F which is below the 85°F set point for storage-to-conditioned space operation (Mode 7).

Space Heating Subsystem - A total of 2.69 million Btu of solar energy was delivered to the subsystem. Of the total auxiliary energy used (2.0 mil-

lion Btu), 1.03 million Btu of thermal energy were apportioned to the air system. A total of 0.56 million Btu of electrical energy was required to operate the subsystem, including the apportioned furnace air handler blower power. Solar energy supplied 62 percent of the 2.69 million Btu subsystem load, resulting in a fossil energy savings of 3.37 million Btu, and electrical energy savings which were negligible.

E. Thermal Performance (Combined Systems)

The thermal performance of the combined liquid and air systems includes the solar energy extracted from the liquid collector loop for use by the DHW subsystem in the calculation for fossil savings and solar fraction. It has not been included in the total load or solar energy used because the auxiliary DHW energy is unknown. Accordingly, the solar fraction of the overall system is high because the missing auxiliary energy factor which, as a nominal part of the total load, is in the denominator of the solar fraction expression. The Rademaker DHW load is estimated to be 10 percent or less of the heating load and, therefore, this effect is not great.

A total of 5.38 million Btu of solar energy was delivered to the space heating subsystems and 0.64 million Btu were delivered to the DHW preheating subsystem. From the 4.80 million Btu of fossil energy available to the furnace, 2.0 million Btu of thermal energy were delivered to heat exchanger HX5. A total of 2.05 million Btu of electrical energy was required to operate the system. The solar fraction was 6.3 percent. The solar energy used resulted in fossil energy savings of 8.17 million Btu, at an electrical energy cost of 0.56 million Btu.

F. Observations

There is no change in the nature of spurious air flow due to the malfunction of damper D1 previously reported. The effect is not as pronounced as in previous winter months because of the lower heating load. The auxiliary storage tank in the air system is completely ineffectual and should not be used in the system.

G. Energy Savings

During April, the combined system fossil energy savings, including the solar contribution to the DHW Subsystem, were 8.17 million Btu. These savings are based on a furnace efficiency of 0.60 in the conversion of fossil energy to usable thermal energy. The electrical energy savings were 0.56 million Btu which is the equivalent operating energy that would have been required to satisfy the observed monthly load by the gas furnace less the operating energy that was used.

The following percentage of time in the month of April that the air system operated in the solar mode and the total system operated in the non-solar modes is listed:

No Solar Operation	15.5 Percent
Solar Operation	39.0 Percent
Auxiliary Heating Only	5.8 Percent
Ventilating Only	39.7 Percent

During solar operation, the air system had the following breakdown of time duration:

Collector-to-Load	9.4 Percent
Storage-to-Load	3.8 Percent
Collector-to-Storage	25.8 Percent

III. ACTION STATUS

The site contractor has an open action item to correct the damper leaks and the control of damper D1 which now opens when there is a demand for heating regardless of whether solar energy is available. It has also been recommended to the site contractor that the 158-cubic foot rock thermal storage be completely disabled.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: RADEMAKER CORP.--LIQUID SYSTEM
REPORT PERIOD: APRIL, 1979

SCLAR/2009-79/04

SITE/SYSTEM DESCRIPTION:

THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 10,000 SQ.FT. OFFICE/WAREHOUSE. THIS IS ACCOMPLISHED BY CIRCULATING A 46% PROPYLENE GLYCOL SOLUTION THROUGH 6 FLAT PLATE COLLECTORS TO TRANSFER SCLAR ENERGY TO THE DOMESTIC HOT WATER SUBSYSTEM AND TO A 560 GAL. INSULATED TANK. THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 125,000 BTU/HR. NATURAL GAS FURNACE.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SCLAR CONVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

9.365 MILLION BTU
39022 BTU/SQ.FT.
3.116 MILLION BTU
12984 BTU/SQ.FT.
54 DEGREES F
72 DEGREES F
0.25
0.161 MILLION BTU
1.183 MILLION BTU
6.590 MILLION BTU

SUBSYSTEM SUMMARY:

LOAD
SCLAR FRACTION USED
OPERATING ENERGY
AUX. THERMAL ENERGY
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

FCT WATER
N.A.
N.A.
0.636
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

HEATING
2.692
64
1.722
1.022
0.970
N.A.
2.291
-0.102
3.508

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.692 MILLION BTU
64 PERCENT
2.358 MILLION BTU
1.183 MILLION BTU
0.970 MILLION BTU
N.A. MILLION BTU
2.291 MILLION BTU
-0.264 MILLION BTU
3.508 MILLION BTU

SYSTEM PERFORMANCE FACTOR:

0.432

* DENOTES UNAVAILABLE DATA
‡ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SCLAR DATA PROGRAM, FEBRUARY 28, 1978.
SCLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: RADENAKER CORP.-LIQUID SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

SITE/SYSTEM DESCRIPTION:

THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 10,000 SQ.FT. OFFICE/WAREHOUSE. THIS IS ACCOMPLISHED BY CIRCULATING A 46% PRCFYLENE GLYCOL SOLUTION THROUGH 6 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO THE DOMESTIC HOT WATER SUBSYSTEM AND TO A 560 GAL. INSULATED TANK. THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 125,000 BTU/HR. NATURAL GAS FURNACE.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

9.880 GIGA JOULES
443136 KJ/SQ.M.
3.287 GIGA JOULES
147443 KJ/SQ.M.
12 DEGREES C
22 DEGREES C

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECS SOLAR CONVERSION EFFICIENCY
ECS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

0.25 GIGA JOULES
0.170 GIGA JOULES
1.248 GIGA JOULES
6.952 GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENG
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HCT WATER
N.A.
N.A.
C.67C
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

HEATING
2.840
64
1.817
1.078
1.023
N.A.
2.417
-0.108
3.701

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.840 GIGA JOULES
64 PERCENT
2.487 GIGA JOULES
1.248 GIGA JOULES
1.023 GIGA JOULES
N.A. GIGA JOULES
2.417 GIGA JOULES
-0.278 GIGA JOULES
3.701 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:

0.432

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
CF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/1E

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: RADEMAKER CCRP--LIQUID SYSTEM
REPORT PERIOD: APRIL, 1979
SOLAR/2009-79/04

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LCACS MILLION BTU	AUX THERMAL TC ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.054	53	0.005	NCT	0.001	NCT	0.088
2	0.226	55	0.011		0.006		0.046
3	0.389	47	0.071		0.007		0.184
4	0.058	45	0.043		0.000		0.749
5	0.465	50	0.074	APPLICABLE	0.007	APPLICABLE	0.158
6	0.577	39	0.153		0.007		0.264
7	0.421	44	0.166		0.007		0.396
8	0.053	51	0.016	APPLICABLE	0.001	APPLICABLE	0.301
9	0.038	40	0.000		0.000		0.000
10	0.187	41	0.005		0.006		0.029
11	0.342	63	0.027		0.007		0.080
12	0.238	65	0.055		0.005		0.231
13	0.063	56	0.065		0.002		1.106
14	0.434	55	0.125		0.007		0.288
15	0.551	54	0.180		0.007		0.327
16	0.515	52	0.102		0.007		0.197
17	0.542	53	0.132		0.007		0.243
18	0.520	55	0.165		0.007		0.326
19	0.512	58	0.150		0.007		0.293
20	0.461	65	0.146		0.007		0.316
21	0.259	67	0.052		0.005		0.202
22	0.091	62	0.076		0.001		0.834
23	0.144	63	0.055		0.007		0.411
24	0.164	67	0.020		0.007		0.107
25	*	*	*		*		*
26	0.099	56	0.044		0.004		0.447
27	0.459	53	0.071		0.007		0.155
28	0.165	44	0.070		0.004		0.425
29	0.515	50	0.147		0.008		0.285
30	0.493	57	0.041		0.007		0.082
SUM	9.365	-	2.358	N.A.	0.161	N.A.	-
AVG	0.312	54	0.075	N.A.	0.005	N.A.	0.252
NBS ID	G001	N113			G102		N111

* DENOTES UNAVAILABLE DATA.

& DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: RADEMAKER CCRF-T LIQUID SYSTEM SOLAR/2009-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.054	0.021	0.008	*	0.154
2	0.226	0.209	0.072	62	0.319
3	0.389	0.349	0.147	53	0.380
4	0.058	0.008	0.004	50	0.062
5	0.465	0.432	0.156	55	0.337
6	0.577	0.535	0.187	42	0.324
7	0.421	0.386	0.140	51	0.334
8	0.053	0.018	0.008	53	0.146
9	0.038	0.000	0.000	37	0.000
10	0.187	0.158	0.046	46	0.246
11	0.342	0.326	0.133	77	0.390
12	0.238	0.212	0.073	72	0.307
13	0.063	0.032	0.010	62	0.166
14	0.434	0.405	0.166	68	0.381
15	0.551	0.512	0.202	60	0.367
16	0.515	0.480	0.182	65	0.353
17	0.542	0.508	0.197	65	0.364
18	0.520	0.487	0.191	68	0.359
19	0.512	0.477	0.184	69	0.375
20	0.461	0.437	0.173	79	0.306
21	0.259	0.232	0.075	*	0.054
22	0.091	0.014	0.005	66	0.225
23	0.144	0.126	0.032	69	0.258
24	0.184	0.168	0.047	73	0.258
25	*	*	*	*	*
26	0.099	0.064	0.016	61	0.160
27	0.459	0.432	0.161	66	0.351
28	0.165	0.096	0.020	48	0.119
29	0.515	0.485	0.197	62	0.382
30	0.493	0.456	0.174	65	0.354
SUM	5.365	8.343	3.116	-	-
AVG	0.312	0.278	0.104	61	0.333
NBSID	Q001		G100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT STORAGE PERFORMANCE

SITE: RADEMAKER CCRP.-LIQUID SYSTEM
 REPORT PERIOD: APRIL, 1979
 SCLAR/2009-79/04

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.002	0.000	-0.018	78	-11.862
2	0.059	0.000	0.034	80	0.580
3	0.117	0.050	0.052	91	0.870
4	-0.000	0.041	-0.077	82	98.359
5	0.122	0.047	0.067	88	0.928
6	0.138	0.117	0.011	96	0.926
7	0.082	0.118	-0.034	90	1.027
8	0.001	0.010	-0.046	80	-65.770
9	0.000	0.000	-0.025	75	1.000
10	0.037	0.000	0.019	74	0.503
11	0.099	0.000	0.102	87	1.029
12	0.045	0.031	-0.000	98	0.681
13	0.003	0.064	-0.080	86	-6.376
14	0.103	0.071	0.033	87	1.017
15	0.120	0.107	0.005	91	0.973
16	0.133	0.063	0.068	96	0.993
17	0.139	0.090	0.035	103	0.895
18	0.133	0.124	-0.003	106	0.911
19	0.123	0.102	0.012	106	0.925
20	0.116	0.104	0.005	108	0.538
21	0.036	0.022	-0.012	115	0.281
22	-0.001	0.073	-0.087	105	13.658
23	0.017	0.046	-0.026	88	1.234
24	0.024	0.004	0.021	91	1.058
25	*	*	*	*	*
26	0.006	0.036	-0.041	87	-0.805
27	0.111	0.033	0.068	91	0.911
28	0.006	0.060	-0.092	82	-4.931
29	0.120	0.078	0.033	83	0.920
30	0.123	0.000	0.087	94	0.705
SUM	2.082	1.544	0.118	-	-
AVG	0.069	0.051	0.004	91	0.799
NES ID	G200	G201	G202		N108

* DENOTES UNAVAILABLE DATA.

2 DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: RADEMAKER CORP.-LIQUID SYSTEM
REPORT PERIOD: APRIL, 1979
SOLAR/2009-75/0.

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.CF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	NOT	NCT	0.005	NCT	NOT	NOT	NOT	NOT	NOT	NCT	NOT	NOT
2	NOT	APPLICABLE	0.009	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
3	NOT	APPLICABLE	0.018	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
4	NOT	APPLICABLE	0.001	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
5	NOT	APPLICABLE	0.024	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
6	NOT	APPLICABLE	0.028	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
7	NOT	APPLICABLE	0.032	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
8	NOT	APPLICABLE	0.005	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
9	NOT	APPLICABLE	0.000	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
10	NOT	APPLICABLE	0.006	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
11	NOT	APPLICABLE	0.026	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
12	NOT	APPLICABLE	0.023	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
13	NOT	APPLICABLE	0.006	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
14	NOT	APPLICABLE	0.030	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
15	NOT	APPLICABLE	0.034	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
16	NOT	APPLICABLE	0.035	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
17	NOT	APPLICABLE	0.039	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
18	NOT	APPLICABLE	0.040	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
19	NOT	APPLICABLE	0.043	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
20	NOT	APPLICABLE	0.040	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
21	NOT	APPLICABLE	0.028	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
22	NOT	APPLICABLE	0.001	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
23	NOT	APPLICABLE	0.014	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
24	NOT	APPLICABLE	0.017	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
25	NOT	APPLICABLE	*	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
26	NOT	APPLICABLE	0.008	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
27	NOT	APPLICABLE	0.034	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
28	NOT	APPLICABLE	0.010	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
29	NOT	APPLICABLE	0.023	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
30	NOT	APPLICABLE	0.028	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
SUM	N.A.	-	0.636	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-	-	N.A.
AVG	N.A.	N.A.	0.021	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SPACE HEATING SUBSYSTEM

SITE: RADEMAKER CCRP.-LIQUID SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.CF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.088	0	0.000	0.032	0.088	NCT	0.211	-0.011	0.000	71	53
2	0.043	6	0.002	0.024	0.041		0.094	-0.001	0.003	72	55
3	0.102	52	0.054	0.053	0.049		0.123	-0.008	0.109	72	47
4	0.057	43	0.042	0.031	0.055		0.123	-0.010	0.085	71	45
5	0.108	46	0.050	0.027	0.058		0.140	-0.008	0.102	72	50
6	0.165	76	0.125	0.038	0.040		0.108	-0.009	0.254	71	39
7	0.205	66	0.135	0.058	0.071		0.140	-0.016	0.274	71	44
8	0.130	8	0.011	0.035	0.119		0.269	-0.013	0.022	71	51
9	0.117	0	0.000	0.010	0.117		0.252	-0.001	0.000	71	40
10	0.120	1	-0.000	0.026	0.121		0.277	-0.009	-0.000	72	41
11	0.062	3	0.001	0.027	0.061		0.129	-0.005	0.003	74	63
12	0.032	102	0.032	0.012	0.000		0.011	0.000	0.065	74	65
13	0.064	100	0.064	0.043	0.000		0.011	0.000	0.130	72	56
14	0.114	83	0.095	0.043	0.020		0.013	0.000	0.193	70	55
15	0.172	85	0.146	0.045	0.026		0.012	0.000	0.297	72	54
16	0.089	75	0.066	0.045	0.022		0.064	-0.002	0.135	72	52
17	0.056	97	0.093	0.046	0.003		0.025	-0.003	0.189	73	53
18	0.131	99	0.130	0.042	0.001		0.017	-0.002	0.264	73	55
19	0.107	100	0.107	0.029	0.000		0.015	0.000	0.218	74	58
20	0.106	100	0.106	0.042	0.000		0.017	0.000	0.215	75	65
21	0.024	103	0.024	0.001	0.000		0.017	0.000	0.050	73	67
22	0.075	100	0.075	0.005	0.000		0.010	0.000	0.152	72	62
23	0.045	103	0.045	0.042	0.000		0.011	0.000	0.092	74	63
24	0.003	141	0.003	0.022	0.000		0.015	0.000	0.006	75	67
25	*	*	*	*	*		*	*	*	*	*
26	0.037	102	0.037	0.035	0.000		0.010	0.000	0.074	73	56
27	0.037	100	0.037	0.025	0.000		0.018	0.000	0.075	72	53
28	0.061	101	0.061	0.043	0.000		0.016	0.000	0.123	69	44
29	0.155	80	0.124	0.060	0.030		0.014	0.000	0.253	68	50
30	0.019	16	0.003	0.017	0.017		0.053	-0.000	0.006	71	57
SUM	2.692	-	1.722	1.022	0.970	N.A.	2.291	-0.102	3.508	-	-
AVG	0.090	64	0.057	0.034	0.032	N.A.	0.076	-0.003	0.117	72	54
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NCT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENVIRONMENTAL SUMMARY

SOLAR/2009-79/04

SITE: RADEMAKER CCRP.-LIQUID SYSTEM
REPORT PERIOD: APRIL, 1975

DAY OF MONTH	TOTAL INSCALATION BTU/SG.FT	DIFFUSE INSCALATION BTU/SG.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	224	NCT	53	*	NCT	NCT	NCT
2	942		55	62			
3	1619		47	53			
4	241		45	50			
5	1937		50	55			
6	2406		39	43			
7	1752		44	51			
8	222		51	53			
9	158		40	37			
10	779		41	46			
11	1426		63	77			
12	991		63	72			
13	262		56	62			
14	1810		55	68			
15	2295		54	60			
16	2148		52	65			
17	2260		53	68			
18	2165		55	65			
19	2133		58	69			
20	1921		65	79			
21	1078		67	*			
22	377		62	66			
23	601		63	69			
24	766		67	73			
25	*		*	*			
26	412		56	61			
27	1912		53	66			
28	688		44	48			
29	2147		50	62			
30	2052		57	65			
SUM	35022	N.A.	-	-	-	-	-
AVG	1301	N.A.	54	61	N.A.	N.A.	N.A.
NBS ID	G001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.

2 DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: RADEMAKER CORP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

SITE/SYSTEM DESCRIPTION:

THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 10,000 SQ.FT. OFFICE/WAREHOUSE. THIS IS ACCOMPLISHED BY CIRCULATING AIR THROUGH 10 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO EITHER THE OFFICE AREA OR TO A 236 CU.FT. THERMAL STORAGE UNIT. THE SYSTEM IS AUGMENTED BY HEAT FROM A 125,000 BTU/HR. NATURAL GAS FURNACE.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

7.982 MILLION BTU
40934 BTU/SQ.FT.
2.193 MILLION BTU
11247 BTU/SQ.FT.
54 DEGREES F
72 DEGREES F

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SOLAR CONVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

0.21 MILLION BTU
0.299 MILLION BTU
0.862 MILLION BTU
5.566 MILLION BTU

SUBSYSTEM SUMMARY:

LOAD FACT WATER
SOLAR FRACTION N.A.
SOLAR ENERGY USED N.A.
OPERATING ENERGY N.A.
AUX. THERMAL ENERGY N.A.
AUX. ELECTRIC FUEL N.A.
AUX. FOSSIL FUEL N.A.
ELECTRICAL SAVINGS N.A.
FOSSIL SAVINGS N.A.

HEATING N.A.
2.685
62
1.656
0.563
1.029
N.A.
2.511
0.003
3.372

COOLING N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.685 MILLION BTU
62 PERCENT
1.656 MILLION BTU
0.563 MILLION BTU
1.029 MILLION BTU
N.A. MILLION BTU
2.511 MILLION BTU
-0.296 MILLION BTU
3.372 MILLION BTU

SYSTEM PERFORMANCE FACTOR:

0.455

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/1E

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: RADEMAKER CORP.--AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

SITE/SYSTEM DESCRIPTION:

THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 10,000 SQ.FT. OFFICE/WAREHOUSE. THIS IS ACCOMPLISHED BY CIRCULATING AIR THROUGH 10 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO EITHER THE OFFICE AREA OR TO A 236 CU.FT. THERMAL STORAGE UNIT. THE SYSTEM IS AUGMENTED BY HEAT FROM A 125,000 BTU/HR. NATURAL GAS FURNACE.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

8.421 GIGA JOULES
464846 KJ/SQ.M.

COLLECTED SOLAR ENERGY

2.314 GIGA JOULES
127726 KJ/SQ.M.
12 DEGREES C
22 DEGREES C

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SOLAR CONVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

0.21 GIGA JOULES
0.315 GIGA JOULES
0.909 GIGA JOULES
5.872 GIGA JOULES

SUBSYSTEM SUMMARY:

LCAD
SOLAR FRACTION USED
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENG
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HEATING
2.833
62
1.747
0.594
1.086
N.A.
2.650
0.003
3.558

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.833 GIGA JOULES
62 PERCENT
1.747 GIGA JOULES
0.909 GIGA JOULES
1.086 GIGA JOULES
N.A. GIGA JOULES
2.650 GIGA JOULES
-0.312 GIGA JOULES
3.558 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:

0.455

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: RADEMAKER CCRP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TC LOADS MILLION BTU	AUX THERMAL TC ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.047	53	0.010	NCT	0.005	NCT	0.220
2	0.191	55	0.025		0.010		0.130
3	0.380	47	0.081		0.012		0.213
4	0.050	45	0.011		0.004		0.216
5	0.392	50	0.064		0.012		0.163
6	0.476	39	0.089		0.011		0.188
7	0.354	44	0.082		0.013		0.232
8	0.046	51	0.007		0.004		0.148
9	0.033	40	0.000		0.000		-0.004
10	0.162	41	0.014		0.011		0.088
11	0.287	63	0.046		0.011		0.161
12	0.203	65	0.030		0.010		0.148
13	0.056	56	0.030		0.006		0.546
14	0.360	55	0.101		0.013		0.279
15	0.463	54	0.122		0.014		0.263
16	0.431	52	0.083		0.012		0.192
17	0.456	53	0.089		0.011		0.196
18	0.436	55	0.099		0.012		0.226
19	0.430	58	0.097		0.012		0.227
20	0.393	65	0.051		0.009		0.232
21	0.218	67	0.038		0.006		0.174
22	0.080	62	0.016		0.006		0.203
23	0.128	63	0.026		0.011		0.203
24	0.159	67	0.027		0.012		0.171
25	*	*	*		*		*
26	0.067	56	0.015		0.007		0.172
27	0.392	53	0.074		0.012		0.188
28	0.141	44	0.035		0.014		0.248
29	0.441	50	0.136		0.014		0.309
30	0.424	57	0.062		0.012		0.145
SLM	7.982	-	1.656	N.A.	0.299	N.A.	-
AVG	0.266	54	0.055	N.A.	0.010	N.A.	0.207
NBS ID	G001	N113			G102		N111

* DENOTES UNAVAILABLE DATA.
 & DENOTES NULL DATA.
 N.A. DENOTES NCT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: RADEMAKER CCRF.-AIR SYSTEM
REPORT PERIOD: APRIL, 1975
SOLAR/2005-79/04

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.047	0.020	0.004	*	0.087
2	0.191	0.185	0.048	62	0.253
3	0.380	0.366	0.104	53	0.273
4	0.050	0.028	0.000	50	0.002
5	0.392	0.377	0.055	55	0.252
6	0.476	0.441	0.114	43	0.240
7	0.354	0.347	0.101	51	0.285
8	0.046	0.029	0.002	53	0.043
9	0.033	0.003	-0.000	37	-0.012
10	0.162	0.144	0.015	46	0.092
11	0.287	0.279	0.092	77	0.321
12	0.203	0.191	0.045	72	0.219
13	0.056	0.042	0.008	62	0.151
14	0.360	0.346	0.116	68	0.321
15	0.463	0.451	0.141	60	0.304
16	0.431	0.415	0.134	65	0.311
17	0.456	0.444	0.138	65	0.303
18	0.436	0.403	0.137	68	0.315
19	0.430	0.416	0.136	69	0.316
20	0.392	0.382	0.129	79	0.329
21	0.218	0.213	0.057	*	0.264
22	0.080	0.055	0.010	66	0.126
23	0.128	0.120	0.031	69	0.245
24	0.159	0.153	0.040	72	0.255
25	*	*	*	*	*
26	0.087	0.067	0.012	61	0.136
27	0.392	0.382	0.118	66	0.300
28	0.141	0.131	0.014	48	0.096
29	0.441	0.432	0.144	62	0.327
30	0.424	0.411	0.130	65	0.307
SUM	7.982	7.535	2.193	-	-
AVG	0.266	0.251	0.073	61	0.275
NBSID	QCC1		G100		N100

* DENOTES UNAVAILABLE DATA.
Q DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT STORAGE PERFORMANCE

SITE: RADEMAKER CCRP.--AIR SYSTEM
REPORT PERIOD: APRIL, 1979
SOLAR/2009-79/04

DAY OF MONT	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORAGE ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.004	-0.016	66	1.000
2	0.028	0.001	0.024	69	0.884
3	0.048	0.032	0.004	73	0.757
4	0.000	0.007	-0.027	67	-365.662
5	0.048	0.015	0.025	71	0.933
6	0.058	0.044	-0.006	74	0.653
7	0.032	0.021	-0.007	69	0.456
8	0.000	0.004	-0.017	65	1.000
9	-0.000	-0.009	0.004	65	317.086
10	0.010	0.004	0.000	66	0.441
11	0.048	0.001	0.042	72	0.891
12	0.013	0.005	0.003	78	0.595
13	0.005	0.025	-0.034	72	-1.760
14	0.030	0.020	-0.002	69	0.625
15	0.027	0.015	-0.003	69	0.454
16	0.050	0.006	0.034	72	0.799
17	0.061	0.023	0.019	77	0.686
18	0.060	0.040	0.003	79	0.721
19	0.058	0.032	0.005	80	0.631
20	0.057	0.030	0.009	81	0.682
21	0.005	0.003	-0.011	85	-0.883
22	-0.003	0.007	-0.025	80	6.545
23	0.011	0.007	0.004	75	0.994
24	0.006	0.000	0.008	77	1.353
25	*	*	*	*	*
26	0.003	0.006	-0.018	74	-3.732
27	0.051	0.015	0.023	76	0.737
28	0.000	0.022	-0.048	68	1.000
29	0.005	0.002	-0.003	64	-0.118
30	0.061	-0.002	0.055	74	0.877
SUM	0.806	0.398	0.044	-	-
AVG	0.027	0.013	0.001	73	0.548
NBS ID	G200	G201	G202		N108

* DENOTES UNAVAILABLE DATA.

2 DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: RADEMAKER CORP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.CF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FCSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FCSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	NOT APPLICABLE											
2	NOT APPLICABLE											
3	NOT APPLICABLE											
4	NOT APPLICABLE											
5	NOT APPLICABLE											
6	NOT APPLICABLE											
7	NOT APPLICABLE											
8	NOT APPLICABLE											
9	NOT APPLICABLE											
10	NOT APPLICABLE											
11	NOT APPLICABLE											
12	NOT APPLICABLE											
13	NOT APPLICABLE											
14	NOT APPLICABLE											
15	NOT APPLICABLE											
16	NOT APPLICABLE											
17	NOT APPLICABLE											
18	NOT APPLICABLE											
19	NOT APPLICABLE											
20	NOT APPLICABLE											
21	NOT APPLICABLE											
22	NOT APPLICABLE											
23	NOT APPLICABLE											
24	NOT APPLICABLE											
25	NOT APPLICABLE											
26	NOT APPLICABLE											
27	NOT APPLICABLE											
28	NOT APPLICABLE											
29	NOT APPLICABLE											
30	NOT APPLICABLE											
SUM	N.A.	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-	-	N.A.
AVG	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NBS	Q302	N30C	G300	G303	G301	G305	G306	G311	G313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SPACE HEATING SUBSYSTEM

SITE: RADEMAKER CORP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SOLAR/2009-79/04

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.CF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FCSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.098	12	0.010	0.018	0.088	N	0.210	-0.000	0.021	71	53
2	0.066	38	0.025	0.020	0.041	D	0.090	0.000	0.051	72	55
3	0.130	62	0.081	0.037	0.049	T	0.119	-0.001	0.165	72	47
4	0.081	14	0.011	0.010	0.070		0.151	-0.001	0.022	71	45
5	0.122	52	0.064	0.016	0.058	A	0.135	-0.000	0.130	72	50
6	0.147	61	0.089	0.017	0.058	P	0.147	0.001	0.182	71	39
7	0.155	42	0.082	0.024	0.112	P	0.241	0.003	0.168	71	44
8	0.128	7	0.007	0.018	0.121	L	0.273	-0.001	0.014	71	51
9	0.117	0	-0.000	0.010	0.117	I	0.252	-0.000	-0.000	71	40
10	0.132	12	0.014	0.016	0.118	C	0.276	0.000	0.029	72	41
11	0.107	43	0.046	0.022	0.061	A	0.129	0.000	0.094	74	63
12	0.030	100	0.030	0.005	0.000	E	0.013	0.000	0.061	74	65
13	0.030	100	0.030	0.013	0.000	L	0.016	0.000	0.062	72	56
14	0.107	54	0.101	0.015	0.007		0.013	0.000	0.205	70	55
15	0.132	92	0.122	0.014	0.010		0.013	0.000	0.248	72	54
16	0.105	75	0.083	0.028	0.022		0.060	0.000	0.168	72	52
17	0.110	81	0.085	0.024	0.021		0.065	0.001	0.182	73	53
18	0.111	85	0.099	0.024	0.012		0.043	0.001	0.201	73	55
19	0.097	100	0.097	0.025	0.000		0.012	0.000	0.198	74	58
20	0.091	100	0.091	0.031	0.000		0.013	0.000	0.186	75	65
21	0.038	100	0.038	0.001	0.000		0.013	0.000	0.077	73	67
22	0.016	100	0.016	0.002	0.000		0.017	0.000	0.033	72	62
23	0.026	100	0.026	0.024	0.000		0.017	0.000	0.053	74	63
24	0.027	100	0.027	0.022	0.000		0.012	0.000	0.055	75	67
25	0.015	100	0.015	0.015	0.000		0.013	0.000	0.030	73	56
26	0.074	100	0.074	0.018	0.000		0.010	0.000	0.150	72	53
27	0.035	103	0.035	0.023	0.000		0.014	0.000	0.071	69	44
28	0.150	91	0.136	0.026	0.014		0.014	0.000	0.277	68	50
29	0.078	75	0.062	0.016	0.017		0.045	-0.000	0.125	71	57
SUM	2.685	-	1.656	0.563	1.029	N.A.	2.511	0.003	3.372	-	-
AVG	0.089	62	0.055	0.019	0.034	N.A.	0.084	0.000	0.112	72	54
NBS	Q402	N400	Q400	G403	G401		G410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENVIRONMENTAL SUMMARY

SITE: RADEMAKER CORP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979

SCLAR/2005-79/04

DAY OF MONTH	TOTAL INSCLATION BTU/SG.FT	DIFFUSE INSCLATION BTU/SG.FT	AMBIENT TEMPERATURE DEG F	CAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	243	N	53	*	N	N	N
2	978	C	55	62	C	C	O
3	1951	T	47	53	T	T	T
4	259		45	50			
5	2011	A	50	55	A	A	A
6	2441	P	39	43	P	P	P
7	1816	P	44	51	P	P	P
8	227	L	51	53	L	L	L
9	168	I	40	37	I	I	I
10	829	C	41	46	C	C	C
11	1474	A	63	77	A	A	A
12	1043	P	65	72	P	P	P
13	266	P	56	62	P	P	P
14	1847	E	55	60	E	E	E
15	2375		54	65			
16	2213		52	65			
17	2339		53	65			
18	2237		55	68			
19	2206		58	69			
20	2017		65	79			
21	1116		67	*			
22	405		62	66			
23	654		63	69			
24	814		67	73			
25	*		*	*			
26	444		56	61			
27	2012		53	66			
28	721		44	48			
29	2261		50	62			
30	2172		57	65			
SUM	40934	N.A.	-	-	-	-	-
AVG	1364	N.A.	54	61	N.A.	N.A.	N.A.
NBS ID	0001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
AUXILIARY STORAGE PERFORMANCE

SITE: RADEMAKER CORP.--AIR SYSTEM
REPORT PERIOD: APRIL, 1979
SOLAR/2009-79/04

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	INCREASE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.000	-0.004	64	44.516
2	0.003	0.000	0.006	64	-463.064
3	0.004	0.000	0.002	65	22.063
4	0.000	0.000	-0.008	64	77.046
5	0.004	0.000	0.005	64	-16.146
6	0.005	0.000	0.002	66	14.883
7	0.003	0.001	-0.004	65	8.653
8	0.000	0.000	-0.005	63	30.272
9	0.000	0.000	-0.001	63	1.000
10	0.001	-0.000	0.000	62	-5.020
11	0.004	0.000	0.011	64	109.052
12	0.004	0.000	0.006	67	-16.104
13	0.001	0.000	-0.007	67	761.588
14	0.002	0.001	-0.002	65	5.533
15	0.002	0.001	-0.002	65	4.457
16	0.004	0.000	0.005	65	-2.889
17	0.006	0.000	0.005	67	8.165
18	0.006	0.000	0.003	68	8.026
19	0.006	0.000	0.002	69	29.368
20	0.006	0.000	0.004	70	15.573
21	0.004	0.000	-0.000	71	912.622
22	0.001	0.000	-0.005	70	216.185
23	0.002	0.000	0.001	70	45.684
24	0.003	0.000	0.002	70	1.000
25	*	*	*	*	*
26	0.001	0.000	-0.003	70	754.697
27	0.004	0.000	0.002	69	13.730
28	0.000	0.001	-0.012	67	16.568
29	0.001	0.000	-0.004	65	5.882
30	0.005	0.000	0.010	66	-72.337
SUM	0.085	0.006	0.011	-	-
AVG	0.003	0.000	0.000	66	12.435

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
EXTRA LCAC SUBSYSTEM

SITE: RADEMAKEF CORP.-AIR SYSTEM
REPORT PERIOD: APRIL, 1979
SOLAR/2005-79/04

DAY OF MONTH	LOAD MILLION BTU	SOLAR FRACTION CF LCAC PERCENT	SOLAR ENERGY USED MILLION BTU	CFER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU
1	0.186	6	0.011	0.056	0.176		0.421	-0.017	0.031
2	0.108	24	0.026	0.060	0.082	N	0.184	-0.016	0.072
3	0.232	58	0.135	0.108	0.098	C	0.241	-0.028	0.311
4	0.178	30	0.053	0.045	0.125	T	0.275	-0.014	0.110
5	0.230	49	0.114	0.062	0.117	A	0.276	-0.027	0.280
6	0.212	65	0.214	0.072	0.098	P	0.255	-0.026	0.453
7	0.400	55	0.217	0.102	0.183	P	0.381	-0.032	0.507
8	0.258	8	0.018	0.057	0.240	L	0.543	-0.019	0.047
9	0.233	-0	0.000	0.021	0.233	I	0.504	-0.001	0.000
10	0.252	6	0.014	0.058	0.232	C	0.553	-0.026	0.040
11	0.165	28	0.047	0.067	0.121	A	0.257	-0.024	0.149
12	0.062	100	0.062	0.032	0.000	B	0.023	-0.015	0.173
13	0.054	100	0.054	0.065	0.000	L	0.027	-0.007	0.203
14	0.222	90	0.155	0.078	0.026	E	0.025	-0.020	0.460
15	0.304	90	0.268	0.080	0.036		0.124	-0.021	0.616
16	0.193	77	0.149	0.052	0.044		0.090	-0.022	0.375
17	0.206	88	0.182	0.097	0.024		0.061	-0.019	0.450
18	0.241	54	0.228	0.084	0.013		0.026	-0.019	0.546
19	0.204	100	0.204	0.083	0.000		0.029	-0.019	0.504
20	0.197	100	0.157	0.053	0.000		0.029	-0.014	0.483
21	0.062	100	0.062	0.017	0.000		0.027	-0.006	0.184
22	0.051	100	0.051	0.017	0.000		0.027	-0.018	0.187
23	0.071	100	0.071	0.084	0.000		0.027	-0.019	0.173
24	0.030	100	0.030	0.064	0.000		0.027	-0.019	0.095
25	*	*	*	*	*		*	*	*
26	0.051	100	0.051	0.061	0.000		0.023	-0.011	0.120
27	0.111	100	0.111	0.077	0.000		0.028	-0.019	0.295
28	0.095	100	0.095	0.084	0.000		0.030	-0.018	0.214
29	0.305	86	0.260	0.108	0.044		0.028	-0.022	0.577
30	0.097	66	0.064	0.052	0.033		0.098	-0.020	0.208
SUM	5.377	-	3.378	2.045	1.999	N.A.	4.802	-0.559	8.174
AVG	0.179	63	0.113	0.068	0.067	N.A.	0.160	-0.019	0.272

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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